E-ISSN 2039-2117
ISSN 2039-9340

Mediterranean Journal of Social Sciences
MCSER Publishing, Rome-Italy

Vol 5 No 1
January 2014

Exploring Mathematics Anxiety: Mathematics Students' Experiences

Paul Mutodi

Department of Maths, Science and Technology, University of Limpopo (Turfloop Campus)
E-mail: paul.mutodi@ul.ac.za

Hlanganipai Ngirande

Department of Business Management, University of Limpopo (Turfloop Campus)
E-mail: hlanganipai.ngirande@ul.ac.za

Doi:10.5901/mjss.2014.v5n1p283

Abstract

The purpose of this research was to explore students' mathematics anxiety levels at a selected tertiary institution in South Africa. Mathematics achievement is a top priority in the world over. South Africa lags behind in mathematics education and must do everything to develop effective strategies for the instruction of mathematics. The research examined the differences in mathematics anxiety levels according to gender, age and home language. This study examined responses to a questionnaire administered to students, utilizing a quantitative research. Data on perceived notions of students' mathematical experiences was collected. The study involved 120 respondents (84 male and 36 female) randomly selected. The instrument used to measure mathematics anxiety levels was adopted from Jerran's Maths Centre (2012). The data was analysed using Statistical Package for the Social Sciences (SPSS), version 20.0. Hypotheses were formulated to test the information that was generated. A t-test for the difference between means of the anxiety levels of males and females, Chi–square tests for association and ANOVA for testing differences among language backgrounds and anxiety levels were used as statistical analyses to measure responses. The findings of the study indicated that there are high mathematics anxiety levels among the respondents. The results also show high levels of mathematics anxiety among female students. The t-test showed that the mean difference between mathematics anxiety and gender is significant. Based on the findings of this study, it is worth noting that mathematics anxiety is one psychological factor that affects students' achievement and their general practices. Therefore, facilitators/teachers should strive to understand mathematics anxiety and implement teaching and learning strategies and study habits that can help them overcome anxiety.

Keywords: *Mathematics Anxiety; Stress, Avoidance, anxiety level, Math phobia*

1. Introduction

South Africa is facing an epidemic in many schools and tertiary institutions called math-phobia, an extreme fear of mathematics. The affective components of learning are often overlooked. One such component is anxiety. Many students never really developed a solid foundation in basic mathematics. Because math is an accumulative discipline, that is complex concepts are built cumulatively on more simple concepts, a student who has not developed a solid math foundation will have trouble learning higher order math. Mathematics is often considered as a difficult subject. Research has shown that many students have learning difficulties and show poor performance in mathematics. One of the attributed reasons is the anxiety that an individual may have towards mathematics. There are numerous definitions of mathematics anxiety. Tobias and Weissbrod (1980), and Fiore (1999) define math anxiety as "the panic, helplessness, paralysis, and mental disorganization that arises among some people when they are required to solve a mathematical problem" (p 403). Pradeep (2006) defined mathematics anxiety is a state of a sinking feeling, uncertainty and despair at doing and understanding mathematics. Although there is on-going debate about the causes of math anxiety, achievement and performance were improved when math anxiety was reduced (Wilbert, 2006). Vinson (2001) also noted that mathematics power is increased when anxiety is diminished.

Mathematics anxiety affects student achievement and attitude towards mathematics (Hembree, 1990). It may lead to poor performance and avoidance of mathematics. Many people think of mathematics as a punishment or something that induces stress (Zaslavsky, 1999). There are many causes postulated for math anxiety. Arem (2003) equates great amounts of math anxiety with test anxiety, and says it's three- fold: poor test-taking strategies, poor test preparation and

psychological pressures. According to Dodd (1999), the lack of confidence is probably the math-anxious learner's greatest obstacle. Zopp (1999) found that unrelated life events, trigger events in education and a lack of support contributed to math anxiety. In addition, parents with math anxiety pass it along to their children, while teachers with math anxiety pass it along to their students (Fiore 1999). Preis and Biggs (2001) pointed that male students had higher math anxiety than females, while Karimi and Venkatesan (2009) noted that females scored higher than males. However, Lusser (1996) failed to find a significant relationship between gender and math anxiety, suggesting other factors such as mathematics background had to be envisaged.

According to Perry (2004) a mathematics student can seriously hamper her or his performance by being nervous and insecure toward mathematics. Most mathematics teachers would agree that mathematics anxiety stems primarily from students' fears of failure and feeling of inadequacy. In most cases, mathematics anxiety is not extreme or overwhelming, yet it continues to haunt most students throughout their encounter with mathematics (Usop *et al*., 2001). Mathematics anxiety could also develop as a result of a student's prior negative experiences learning mathematics in the classroom or at home (Rossnan, 2006). A study by Vukovic, Roberts and Wright (2013) on home-school mediation analyses demonstrated that parental home support and expectations influenced students' performance and reasoning by reducing their mathematics anxiety. Fears and anxiety about maths may have more widespread consequences. If lecturers who are anxious about maths are charged with teaching students mathematics, their anxieties could have consequences for their students' maths achievement.

Makari (2012) defined anxiety is a general term for several disorders that cause nervousness, fear, apprehension, and worrying. The fear of not being able to do the math or the fear that it's too hard or the fear of failure which often stems from lack of confidence. Mathematics anxiety affects how students feel and behave. It is common to experience moments of anxiety inside or outside a mathematics class. For some students severe anxiety may lead to math phobia while for others it may lead to improved achievement. Math avoidance results in less competency, exposure and math practice, leaving students more anxious and mathematically unprepared to achieve (Ashcraft, 2002). Students who have had bad experiences learning math often develop this phobia and, in turn, struggle learning various concepts because they feel they are unable to do the mathematics.

A number of math anxiety researchers suggest that some instructional strategies for teaching mathematics and facilitators' training, beliefs are some of the underlying causes of math anxiety (Ashcraft, 2002; and Hellum, 2010). Math anxiety is often due to poor teaching and poor experiences in math that typically leads to math anxiety (Nebraska MATH, 2012). Russell (2008) viewed math anxiety is an emotional, rather than an intellectual problem. However, some researchers argue that math anxiety can interfere with a person's ability to learn math and therefore become an intellectual problem. Failure experiences in mathematics and fear of future failures were also identified as the major contributing factors to mathematics anxiety and phobia.

Research showed that many of the students with math anxiety have revealed an over reliance on mathematical procedures as opposed to actually understanding the mathematics concept. When students resort to memorizing procedures, rules, and routines without much understanding, the concept is forgotten and panic sets in. Experts argue that "math anxiety" can bring about rife, intergenerational discomfort with the subject, which brings effects ranging from fewer students pursuing math and science careers to less public interest in the subject. Math anxiety feels negative emotions when engaging in an activity that requires numerical or math skills (Sparks, 2011). Math anxiety can become a generational problem, with adults uncomfortable with math passing negative feelings on to their children or students.

Math anxiety is a real problem facing students and teachers in South African schools (Hlalele, 2012).There are many symptoms of math anxiety including unwillingness to attempt mathematics work, classwork and being unusually nervous when in mathematics class. Math anxiety hinders students' working memory (Perina, 2002). The main cause of math anxiety is the teacher himself. It has been shown that students tend to internalize their instructor's interest in and enthusiasm for teaching math (Jackson and Leffingwell, 1999). The teaching of mathematics in South African schools is among the worst in the world (Timss, 2011). Mounting indicators on school performance and teaching reveal poor teaching of mathematics in the great majority of schools (Bernstein, McCarthy, Oliphant, 2013). Some teachers have a bad attitude about mathematics and their lack of confidence in their practices trigger anxiety in their students. However, the teacher can take many steps to reduce math anxiety including reviewing basic mathematics skills, by making sure students understand the mathematical language, and by providing a support system for their students (Schwartz, 2000). The more a teacher understands math anxiety the more he will be able to prevent it and help students overcome it.

2. Statement of the Problem

Math anxiety is a common problem among South African students. Much anxiety is experienced in classrooms due to number of reasons. Lack of teachers' consideration of different learning styles among students was identified as one of the major causes of math anxiety. Research about attitudes toward mathematics is important in determining the connection between achievement and math anxiety. Math anxiety has a considerable correlation with student success in mathematics. Helping to determine the causes and means to reduce anxiety would be a great benefit to current and future students of mathematics.

3. Purpose of the Research

The main purpose of this research is:

- To explore the range of math anxiety levels held by South African tertiary level mathematics students.
- To find out if there was any relationship between the students' mathematics anxiety level their selected demographic variables.
- To give recommendations on strategies that can be used by students and facilitators to reduce/overcome maths anxiety.

4. Research Questions

The study sought to answer the following research questions as they pertain to mathematics anxiety:

1. What is the range of math anxiety levels held by South African tertiary level mathematics and mathematics – related science students?

5. Hypotheses

This study postulated that:

H1: There is a significant difference between mathematics anxiety levels and students' some demographic variables (i.e. gender, age and home language).

H2: There a significant association between math anxiety levels and some demographic variables (i.e. gender, age and home language).

6. Literature Review

A number of scholars have attempted to define math anxiety. Duffy and Furner (2002) viewed it as the emotional and mental distress that occurs in some students while attempting to understand mathematics. Tsanwani (2009) also views mathematics anxiety as an irrational and impedimental dread of mathematics. Hlalele (2012) coined maths anxiety as a term used to describe the panic, helplessness, mental paralysis and disorganisation that arise among some individuals when they are required to solve a problem of a mathematical nature. Literature further indicates that mathematics anxiety refers to a person's feelings of tension and anxiety that interfere with the manipulation of numbers and the solving of mathematical problems in a wide variety of ordinary and academic settings (Khatoon & Mahmood, 2010; Leppavirta, 2011; Newstead, 2006; Perry, 2004). Therefore this study viewed the term maths anxiety as some form of discomfort observed while working on mathematical problems, which is usually associated with fear and nervousness to engage in specific mathematics related situations.

Geist(2010), a proponent of new teaching methods that take student thinking into account, also recognizes that gender issues and parental education can play a part in math anxiety. However, he emphasizes the prominent role that teachers play in creating concussive learning atmospheres and setting realistic targets for their students. He noted that high risk tests that value rote learning and memorisation are the main sources of math anxiety. From a contrary view, Lyons (2012) reported that anxiety is a fairly insubstantial obstacle. Therefore, it makes one to question why it appears to have a crippling effect on some students' ability to do mathematics. This gives a neutral explanation of why some students avoid mathematics-related subjects. It is commonly known that anxiety will influence a student's decisions about what classes to take, often leading to avoidance of math (Maloney, 2012).

There is also some lack of agreement about the causes of mathematics anxiety in students. According to Traxler

(2013), it appears that there are three primary causes of math anxiety. These are beliefs, learning environment, and an anticipatory response. These three variables are intertwined and strengthen one another. Beliefs might include negative stereotypes about one's gender or race. Tobias (1993) views cultural belief as a primary cause for female students' math troubles. This describes the conviction that females are less proficient at mathematics. For female students who fail, they are likely to attribute that to their natural disposition. Cognitive restructuring of beliefs could be a partial solution to that problem. Mitt (2012) submits a set of environmental factors that female students are exposed to which may influence their heightened anxiety. The other suggested causes include teacher anxiety, innate characteristics of mathematics, failure and the influence of early-school experiences of mathematics (Newstead, 1996). Exposure to some teaching and learning strategies that rely on behaviourist models such as rote-memorisation of rules and the manipulation of symbols with little or no understanding instead of an integrated conceptual structure can result in affective stumbling blocks for students (Skemp, 1986). Teachers can also create anxiety by placing too much emphasis on memorising formulae, learning mathematics through drill and practice (Greenwood, 1984).

Students who experience mathematics anxiety are more likely to delay completion or not do tasks assigned to them at all (Owens and Newbegin, 1997). As an irrational fear towards mathematical operations in mathematics classes, mathematics anxiety is found to hinder learners' positive thinking about mathematics learning and feeling calm. This fear causes low self-esteem, disappointment and academic failure (Gresham, 2004; Akin & Kurbanoglu, 2011). In this study, the researchers focused on aspects of mathematical anxiety such as students' uneasiness behaviour when doing mathematics, a failure to complete tasks on time and lack of confidence when handling mathematics tasks.

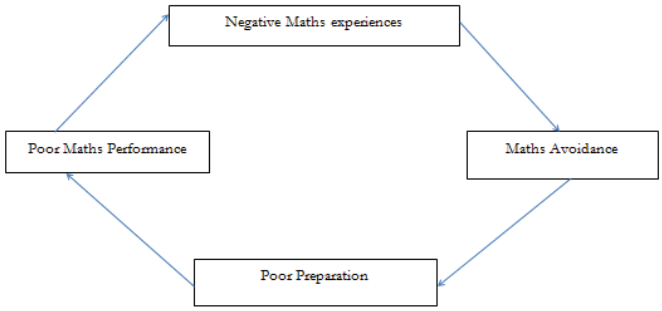
Iossi (2007) identified strategies for minimizing anxiety which include (a) curricular strategies, such as retesting, self-paced learning, distance education, single-sex classes, and math anxiety courses, (b) instructional strategies, such as manipulatives, technology, self-regulation techniques, and communication, and (c) non-instructional strategies, such as relaxation therapy and psychological treatment. Alternative instructional formats such as problem solving, co-operative learning and process-oriented have been suggested in order to prevent or limit mathematics anxiety (von Glasersfeld, 1991; Vacc, 1993 and Greenwood (1984). Reform efforts in the teaching of mathematics have been under way to replace the behaviourist paradigm with methods based on constructivist models of learning such as problem-based learning, inquiry-based learning and guided discovery learning.

Depending on the individual and the task, a moderate amount of anxiety may thus actually facilitate performance (Newstead, 2009). Anxiety at relatively low to moderate levels can be constructive. Beyond a certain point, however, anxiety becomes counterproductive in terms of performance, particularly in the case of higher mental activities and conceptual processes (Skemp, 1986). However most studies found that most students' anxiety levels in their studies ranges from moderate to high (Posamentier, Smith & Stepelman, 2013).Such high levels of math anxiety cause a lot discomfort for many mathematics students and teachers and student lecturers should strive to strike a balance between high subject cognitive demands and high student anxiety levels. Awanta (2000) also lamented that relationship between anxiety and learning of mathematics is complex. He noted that anxiety as a form of arousal of alertness can be helpful in learning but too much anxiety, particularly when combined with perceived lack of ability can hinder learning.

7. Theoretical Model

Pries and Biggs' (2001) cycle of math avoidance will be adopted as a model to explain why students experience math anxiety. According to this model, in first phase, the person experiences negative reactions to math situations. These may derive from past negative experiences with math, and lead to a second phase in which a person avoids math situations. This avoidance leads to phase three, poor mathematics preparation, which brings them to phase four, poor math performance. This generates more negative experiences with math and brings us back to the first phase. This cycle can repeat so often that the math anxious person becomes convinced they cannot do math and the cycle is rarely broken. In essence, students go through this cycle over and over and rarely rebound and are consequently convinced that they cannot do mathematics. Biological studies carried out on mathematics anxiety found that mathematics-anxious individuals have a deficient inhibition mechanism whereby working memory resources are consumed by task irrelevant distracters (Hopko, Ashcraft, Gute, Ruggerio, and Lewis, (1999). According to Jones (2006), students who do poorly in tests and examinations claim that they become confused, are unable to focus on the task at hand, or keep thinking about how poor they are at mathematics. Mathematics anxiety disrupts the on-going, task-relevant activities of working memory, slowing down performance and degrading its accuracy.

Figure 1: Cycle of math avoidance Model



Adopted: Pries and Biggs' (2001).

8. Research Design and Methodology

8.1 Approach

This study is explorative and descriptive and uses a quantitative design to explore students' experience of mathematics anxiety. An explorative design is one in which the major emphasis is on gaining ideas and insights (De Vos, Strydom, Fouché & Delport, 2011). Exploratory research is conducted to provide a better understanding of a situation. It is not designed to come up with final answers or decisions but to produce hypotheses and explanations about what is going on in a situation. The overall goal of this study fits well with the general intention of the exploratory aspect as it sought to provide a basis for formulating more precise questions about rural high school learners' experience of mathematics anxiety in academic settings that can be used to conduct further research. A descriptive research design is one in which the major emphasis is on determining the frequency with which something occurs or the extent to which two variables covary. It provides a picture of the specific details of a situation, a social setting, a relationship (Neuman, 2011) or a picture of a phenomenon as it naturally occurs (Bickman & Rog, 2009). The two approaches seem to blend well due to the nature of this study which begins with a well-defined issue (i.e. mathematics anxiety) and sought to illuminate the basic facts and to create a general picture of the learners' experience (De Vos et al., 2011; Neuman, 2011).

8.2 Respondents

A 10-item questionnaire adopted from Jerran (2012) was randomly distributed to 150 first year students doing mathematics at a selected tertiary institution in Limpopo province of South Africa. Students were asked to indicate their experience of mathematics according to the following alternatives: 1= Disagree; ……5=Agree. It was found that 120 (80%) questionnaires contained valid responses. These were analysed using the Statistical Package for the Social Sciences (SPSS), version 20.0.

9. Reliability and Validity

Reliability refers to the degree of consistency of the data gathering instrument in measuring that which it is supposed to measure. This degree of consistency is measured using Cronbach's alpha coefficient. It is a measure of internal consistency that shows the degree to which all the items in a test measure the same attribute (Masitsa, 2011). It is mandatory that assessors and researchers should estimate this quantity to add validity and accuracy to the interpretation of their data (Tavakol & Dennick, 2011). It ensures that each test item measures the same latent trait on the same scale. In this study, the Cronbach alpha was calculated for the 20-item questionnaire and found to be 0.78 which is viable since an acceptable value must lie between 0.70 and 0.90 (Hof, 2012).

To observe content validity, the questionnaire was adopted and structured so that the questions posed were clearly articulated and directed. All statements were formulated to eliminate the possibility of misinterpretations. This was followed by a pre-tested administered to 87 students who were excluded from the participants in the main study. The identified amendments were made to ensure the simplicity and clarity of some questions, making it fully understandable to the participants (Masitsa, 2011).

10. Results

10.1 Response rate

A follow up of the questionnaires showed a good response rate from the research participants. At the end of the data collection phase, the total number of the completed questionnaires was 120. Given that the sample size of the study was 150, this represented a response rate of 80%.

10.2 Sample Descriptive Summary

Table 1: Demographic variables

Variable	Frequency	Percentages
Gender		
Male	80	67
Female	40	33
Age		
16-20 years	84	70
21 years and above	36	30
Home language		
Sepedi	79	65.8
Shangane	4	3.3
Venda	29	24.2
Swati	6	5.0
Other	2	1.7

Demographic data about the respondents shows that 80 (67%) were males and 40(33%) were females. The majority 84(70%) of the participants were in the 16-20 years category. Sepedi dominated the home languages 79(65.8%) while Venda 29(24.2%) was also notable. The other languages were insignificantly represented. The two languages were dominant at the institution.

Table 2: Descriptive Statistics of Math Anxiety Levels

Item	Description	Mathematics Anxiety Levels					Mean	Mode	Std. Deviation	Skewness
		1	2	3	4	5				
1	I cringe when I have to go to math class.	9	29	20	25	37	3.433	4.000	1.3456	-.245
2	I am uneasy about going to the board in a math class.	8	22	17	37	36	3.592	4.000	1.2735	-.531
3	I am afraid to ask questions in math class.	22	20	13	34	31	3.267	4.000	1.4709	-.328
4	I am always worried about being called on in math class.	19	16	14	43	28	3.375	4.000	1.3906	-.528
5	I understand math now, but I worry that it's going to get really difficult soon	33	21	10	21	35	3.033	3.000	1.6240	-.031
6	I tend to zone out in math class.	20	30	14	20	36	3.183	3.000	1.5062	-.078
7	I fear math tests more than any other kind.	12	26	12	31	39	3.492	4.000	1.3962	-.425
8	I don't know how to study for math tests.	8	23	25	39	25	3.417	4.000	1.2063	-.356
9	It's clear to me in math class, but when I go home it's like I was never there	12	19	24	40	25	3.392	4.000	1.2589	-.445
10	I'm afraid I won't be able to keep up with the rest of the class	9	31	19	26	35	3.392	4.000	1.3429	-.199

The anxiety level frequencies for each item were analysed and are shown in table 2 above. The results showed that the overall mean *(M)* anxiety level was *(M)* =3.3576, with a standard deviation *(SD)* of 0.1595 representing moderate math

anxiety level. The modal *(Mo)* anxiety level for each item was 4.0, acknowledging that most respondents agree that they experience some form of math anxiety either in class or during individual study. Very few (6.7%) indicated that they feel comfortable to go to the board in a math class and the same number confessed that they know how to study for a mathematics test. Another notable feature was the fear of math tests and the tendency to cringe when it is time to go to a math class. These finding supports a study conducted by Smith (2004), which found that students experience anxiety when they know that a test or task is coming. The overall math anxiety level for this study was above moderate. The results of this study also concur with Bidin *et al*. (2003), who found that the students' overall anxiety level was moderate. Pouri (2012) conclude that the students experience low mathematics anxiety during classroom engagement with the teacher but tests and the examinations situation could create high mathematics anxiety for them.

Table 3: Gender and student level of anxiety

		Level of anxiety					
		High level of anxiety	Moderate Level of anxiety	Not sure	No math anxiety	Total	Mean
Gender	**Male**	26	35	17	6	80	**1.988**
	Female	14	10	9	3	40	**2.025**
	Total	40	49	22	9	120	

From table 3 above, the results show that on average female students experience higher levels of math anxiety than males. The mean anxiety level of level of females was M_f=2.025 compared to males M_m= 1.988.

Table 4: Descriptive Statistics (Age and Level of anxiety)

		Level of anxiety					
		High level of anxiety	Moderate Level of anxiety	Not sure	No math anxiety	Total	Mean
Age	**16 - 20 years**	29	31	15	5	80	**1.950**
	21- over	11	18	7	4	40	**2.100**
	Total	40	49	22	9	120	

Results from table 4 above indicate that on average, older students (21 years and above) experience higher levels of maths anxiety than younger students (16 - 20 years). The mean anxiety level of students in the 21 years and above category was M_{older} =2.100 compared to the 16-20 years old category which was $M_{younger}$ =1.950

Table 5: Home language and Level of anxiety

		Level of anxiety					Mean
		High level of anxiety	Moderate Level of anxiety	Not sure	No math anxiety	Total	
Home Language	Venda	13	14	0	2	29	**1.690**
	Shangane	1	3	0	0	4	**1.750**
	Swati	1	3	2	0	6	**1.670**
	Sepedi	23	29	20	7	79	**2.139**
	Other	2	0	0	0	2	**1.000**
Total		**40**	**49**	**22**	**9**	**120**	

Table 5 above shows the distribution of students' anxiety levels according to their language backgrounds. Results indicate that Sepedi was the dominant language among the five languages. However the research findings indicate that all the students from different language backgrounds had moderate to high levels of maths anxiety.

Table 6: Total anxiety levels

Total Anxiety	Frequency	Percentage	Anxiety Level
10-19	8	6.67%	Little math anxiety.
20-29	23	19.17%	You have math anxiety. Fearful about math
30-39	49	40.83%	Moderate math anxiety.
40-50	40	33.33%	High math anxiety.

Table 6 shows that anxiety totals rated out of 50 ranges from 13 to 46. 72.53% of the respondents had math anxiety levels ranging from moderate to high. Nineteen point two percent (19.2%) had fear about mathematics while 6.7% had little level maths anxiety levels.

10.3 Inferential Statistics

In order to test the contribution of the independent variables (gender, age and home language) against the dependent variable (math anxiety level), several statistical models were used. These include the t-test for the difference between means, the Chi-Square to test whether there is an association between independent and dependent variables, Anova to test the significance of the association and Pearson Correlation to test the strength and direction of the relationship between variables.

10.3.1 Tests of Hypotheses

A t-test was conducted to compare the level of mathematics anxiety by gender. Results are shown in the table below (Table 7a). Results from table 7a indicate, the mean score for male students' math anxiety level was M_m= 1.988 with (N = 80, sd = 0.8929), which was slightly lower than the mean score of M_f=2.025 with (N =40, sd = 0.9470) obtained from female students.

Table 7a: One-Sample Test

Mean Anxiety Levels			
Gender	**Mean**	**N**	**Std. Deviation**
Male	1.988	80	.8929
Female	2.025	40	.9470
Total	2.000	120	.9075

The following postulated hypotheses were envisaged to test if gender has a significant effect on math anxiety levels:

H^0: There is no difference in anxiety levels between males and females

H^1: There is a significant difference in anxiety levels between males and females.

A t-test was conducted to test whether there was a significant difference in mathematics anxiety levels between male and female students. The results for the test are shown in table 7b above (df=119, t = 30.854, p=0.00). Therefore, the null hypothesis was rejected since the p-value is less than 0.05. Hence we conclude that there is a significant difference in mathematics anxiety levels between males and females.

Table 7b: T-Test Results

	Test Value = 0				95% Confidence Interval of the Difference	
	t	df	Sig. (2-tailed)	Mean Difference	Lower	Upper
Gender	30.854	119	.000	1.3333	1.248	1.419
Age	77.136	119	.000	3.3333	3.248	3.419
Home language	26.608	119	.000	3.1750	2.939	3.411
Total	49.844	119	.000	33.5750	32.241	34.909

The research also hypothesised that there is a significant difference in anxiety levels between different age groups. To test whether this is the case, a t-test was also conducted. Results for the test are shown in table 7b (df =119, t = 77.136, p=0.00).Therefore, a null hypothesis was rejected since p<0.05. Therefore we conclude that there is a significant difference in the level of mathematics anxiety between the different age cohorts.

To test if there are significant differences among students from different language backgrounds, an Analysis of Variance test was conducted to test the following hypothesis.

H^0 : There is no difference in math anxiety levels among students from different language backgrounds.

H^1 : There is a significant difference in math anxiety levels among students from different language backgrounds

Table 8: ANOVA

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	6.741	4	1.685	2.124	.082
Within Groups	91.259	115	.794		
Total	98.000	119			

The results of the test in table 8 above show that (df = 115, df =4, F= 2.124, p=0.082).Therefore, we do not reject the null hypothesis since p>0.05 and conclude that there are no significant differences in the level of mathematics anxiety among students from different language backgrounds.

Results from the analysis indicated that demographic factors (gender and age) can predict math anxiety levels of the students; however differences in language backgrounds do not have significant effects on math anxiety levels. These observations seem to be consistent with findings from Eiselen (2008) who observed that demographic factors (age and gender) were good predictors of students' maths anxiety levels.

10.4 Chi-Square tests for Associations

Table 9: Crosstabs (Level of Anxiety)

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	1.118[a]	3	.773
Likelihood Ratio	1.113	3	.774
Linear-by-Linear Association	.046	1	.831
N of Valid Cases	120		

a. 1 cells (12.5%) have expected count less than 5. The minimum expected count is 3.00.

A chi square (X^2) test for association was performed by cross tabulating two variables namely gender and math anxiety levels. Results from table 9 above show that (X_3^2 (0.05) = 1.118, df = 3, p=0.773>0.05). Since the p-value is greater than 0.05, it therefore means that we accept the null hypothesis and conclude that there is no association between age and math anxiety level.

Table 10: Home language and Level of Math Anxiety

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	17.991[a]	12	.116
Likelihood Ratio	24.585	12	.017
Linear-by-Linear Association	4.037	1	.045
N of Valid Cases	120		

A chi square (X^2) test for association was performed by cross tabulating two variables namely home language and math anxiety levels. Results from table 10 above also show that (X_{12}^2 (0.05) = 17.991, df = 12, p=0.116>0.05). Since the p-value is greater than 0.05, it therefore means that we accept the null hypothesis and conclude that there is no association between home language and math anxiety level.

Table 11: Age and Level of Math Anxiety

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	1.390[a]	3	.708
Likelihood Ratio	1.385	3	.709
Linear-by-Linear Association	.729	1	.393
N of Valid Cases	120		

a. 1 cells (12.5%) have expected count less than 5. The minimum expected count is 3.00.

A chi square (X^2) test of association was also performed by cross tabulating two variables namely age and math anxiety levels. Results are shown in Table 11 above show that (X_3^2 (0.05) = 1.390, df=3, p=0.708>0.05). Since the p-value is greater than 0.05, it therefore means that we accept the null hypothesis and conclude that there is no association between age and math anxiety level.

11. Discussion of Results

It can be recalled that the purpose of this study was to explore the math anxiety levels of mathematics students at a tertiary institution and to examine the effect of demographic factors, which are gender, age and home language. It was also hypothesized highly that males experience math anxiety less than females.

11.1 Gender and Math Anxiety Level

This study found that there was a significant difference in mathematics anxiety levels of students according to gender. Both descriptive statistics and inferential indicated that males experience less than their female counterparts. This finding is consistent with studies by Bidin et al. (2003); Woodard (2004; Sahin (2008) and Karimi and Venkatesan (2009), which determined that there was a relationship between mathematics anxiety and gender, all of which noted significant differences in mathematics anxiety according to gender, with female students exhibiting higher math anxiety than their male counterparts. However, these findings contradict the findings of Marsh (2004) and Stevens (2013) which concluded that there is no relationship between mathematics anxiety and gender. Long research history in this area has shown that male advantage in mathematics achievement is a universal phenomenon (Mullis et al., 2000). Kaufman (2006) recognized that math interests of males are better than the females from secondary school onwards.

11.2 Age and Math Anxiety Level

This study found that there was a significant difference in mathematics anxiety levels of students according to age. Descriptive statistics indicated that 16-20 year old students experience more math anxiety than their older students. However further inferential statistics proved it insignificant. This is consistent with findings by Calvert (2001) and Hokpo et al. (2003) which revealed that age was not statistically significant in the determination of the level of math anxiety. Rambow (2008) noted that older women experienced a significantly high level of math anxiety. McCarthy (1986)'s findings revealed no significant difference in math anxiety between older and younger students.

11.3 Language and Math Anxiety Level

This study found that there was a significant difference in mathematics anxiety levels of students across different language cohorts. Analysis of variance confirmed that language factors have no effect on the anxiety levels. The fact that South Africa is a multi-cultural and multi-lingual country, students from different language backgrounds tent to experience the same math anxiety. From a contrary view, Tshabalala (2005) reported that mathematics classes are conducted in English and Africans only amongst the 11 official languages, thus students from different language background seem to experience math anxiety differently.

Gender differences in mathematics anxiety have been extensively studied and results are inconsistent, with a number of studies revealing that females have higher levels of mathematics anxiety than males (Alexander & Martray, 1989) and others not confirming significant differences. Baloglu and Kocak (2006) found that gender effects of mathematics anxiety varied with the context. Age is another factor where contradictory findings are reported in the literature. Hembree, (1990), did not find any age-related differences, but Baloglu and Kocak (2006) found that older students exhibited more total mathematics anxiety than younger ones, particularly in mathematics testing and course situations. Craig, Brown, and Baum (2000) had completely different views about math anxiety, arguing that anxiety has its origins in a complex interaction of environmental, psychological, and biological events and processes.

12. Conclusion and Recommendations

This study has implications for all stakeholders, including teachers, schools and parents. Results reveal that high mathematics anxiety levels exist among tertiary students. Gender-related factors have a dominant influence on

mathematics anxiety levels among tertiary students. This study also revealed that age has an effect on students' level of mathematics anxiety. Therefore, teachers should strive to understand mathematics anxiety and implement teaching and learning strategies so that students can overcome their anxiety. The research recommends that teachers/facilitators should be positive and supportive as well as employing teaching methods that empower students to develop positive attitudes towards mathematics. The study also recommends that teachers should demonstrate interest in mathematics in order to raise students' motivation in mathematics as a means of helping students to reduce their math anxiety.

Traditional mathematics classroom practices were identified as causes of great anxiety in many students. The practices include imposed authority, public exposure and time deadlines. To reduce anxiety and tension among students, the study suggests teaching methods which include less lecture, more student directed classes and more discussions. Cooperative groups provide students a chance to exchange ideas, to ask questions freely, to explain to one another, to clarify ideas in meaningful ways and to express feelings about their learning. If these skills are acquired at an early age, they will be greatly beneficial throughout their adult working life. The research recommends a mathematics curriculum that that blends theoretical and practical math.

Math anxiety is a learned response, and, as such, it can be unlearned by exploring and understanding the causes that trigger it. Anxiety is also a physical reaction to stressing situations, and its signs can be identified and controlled by proper cognitive and/or relaxation exercises, like accepting your fears and acknowledging your feelings or practicing a relaxation exercise involving breathing techniques; and also, by having determination, by turning negative-self-talk into positive self-talk, and by creating good study habits.

Much of the anxiety happens in the classroom due to the lack of diversity in learning styles of students. Mathematics must be looked upon with a positive attitude to reduce math anxiety. Therefore, teachers must re-examine traditional teaching methods which often do not match students' learning styles and skills needed in a technologically advanced society. Lessons must be presented in a variety of ways which accommodates students' different learning styles. However, some amount of anxiety is helpful to keep students motivated and energized although anxiety levels need to be closely monitored so that it does not interfere with their ability to do well in class.

References

Arem, C. (1993). Conquering math anxiety: A self-help workbook. Grove, CA: Brooks/Cole.

Awanta, E. (2000). Helping students overcome mathematics anxiety. Journal of the Mathematics Association of Ghana, 12, 58-63.

Ashcraft, M. H. (2002). Math anxiety: Personal, educational, and cognitive consequences. Current Directions in Psychological Science, 11, 181-185.

Dodd, A. W. (1999). Mathematics abused students: Are we prepared to teach them? Mathematics Teacher, 92 (5), 403-406.

Fiore, G. (1999). Math abused students: Are we prepared to teach them? Math Teacher, 92(5), 403-406.

Greenwood, J. (1984). My anxieties about math anxiety. Mathematics Teacher, 77, 662-663.

Hembree, R. (1990). The Nature, Effects, Relief of Mathematics Anxiety. Journal for Research in Mathematics Education, (1), 33–46.

Hellum, A. A (2010). Effective teaching strategies for alleviating math anxiety and increasing self-efficacy in secondary students. Retrieved 7/14/2012 from http://archives.evergreen.edu.

Hlalele, D. (2012). Exploring rural high school learners' experience of mathematics anxiety in academic settings. South African Journal of Education, 32: 3.

Hopko, D. R., Ashcraft, M. H., Gute, J., Ruggerio, K. J., & Lewis, C. (1998). Mathematics anxiety and working memory: Support for the existence of a deficient inhibition mechanism. Journal of Anxiety Disorders, 12 (4), 343-355.

Iossi, L. (2007). Strategies for reducing math anxiety in post-secondary students. In S. M. Nielsen & M. S. Plakhotnik (Eds.), Proceedings of the Sixth Annual College of Education Research Conference: Urban and International Education Section (pp. 30-35). Miami: Florida International University. http://coeweb.fiu.edu/research_conference/

Makari, G. (2012). Brief history of anxiety. New York Times. Retrieved 7/14/2012 from http://opinionator.blogs.nytimes.com/2012/04/16/in-the-arcadian-woods/.

Masitsa, M.G (2011). Exploring safety in township secondary schools in the Free State province. South African Journal of Education, 31:163-174.

Neuman, W.L. (2011). Social research methods: Qualitative and quantitative approaches. Boston: Allyn & Bacon.

Spikell, M. (1993). Teaching mathematics with manipulatives: A resource of activities for the K-12 teacher. New York: Allyn and Bacon.

Tobias, S. (1993). Overcoming math anxiety. New York: W. W. Norton & Company. By A.S.

Posamentier, A.S. Smith, B. S. & Stepelman, J. (2013). Math Anxiety. Pearson Allyn Bacon Prentice Hall.

Geist, E. (2010). The Anti-Anxiety Curriculum: Combating Math Anxiety in the Classroom. Journal of Instructional Psychology, 37(1), 24-31.

Dogan, H. (2012). Emotion, Confidence, Perception and Expectations Case of Mathematics. International Journal of Science & Mathematics Education, 10(1), 49-69.

Hembree, R., (1990). The Nature, Effects, and Relief of Mathematics Anxiety. Journal for Research in Mathematics Education, 21, 1:33-46.

Hof, M. (2012). Questionnaire Evaluation with Factor Analysis and Cronbach's Alpha: *An Example.* Accessed from http://www.let.rug.nl/nerbonne/teach/rema-stats-meth-seminar/student-papers/MHof-QuestionnaireEvaluation-2012-Cronbach-FactAnalysis.pdf.

Khatoon, T. & Mahmood, S. (2010). Mathematics anxiety among secondary school students in India and its relationship to achievement in mathematics. European Journal of Social Sciences, 16 (1), 75-86.

Lyons, I. M., & Beilock, S. L. (2012). When Math Hurts: Math Anxiety Predicts Pain Network Activation in Anticipation of Doing Math. Plos ONE, 7(10), 1-6.

Maloney, E., Beilock S. (2012). Math anxiety: Who has it, why it develops, and how to guard against it. Trends in Cognitive Science, 16, 10: 404-406.

Newstead, K. (1995). Comparison of Young Children's Mathematics Anxiety Across Different Teaching Approaches, Unpublished Ph.D. Dissertation, Cambridge University.

Perina, K. (2002). The sum of all fears. Psychology Today, 35(6), 19.

Perry, A.B. (2004). Decreasing math anxiety in college students. College Student Journal, 38 (2), 321-324.

Perry, N.E., Vandekamp, K.O., Mercer, L,K., & Nordby, C.J.(2002). Investigating teacher-student interactions that foster self-regulated learning. Educational Psychologist,37(1), 5-15.

Karimi, A., & Venkatesan, A. (2009). Mathematics Anxiety, Mathematics Performance and Academic Hardiness in High School Students. International Journal of Educational Science, 1(1): 33-37.

Preis, C. & Biggs, B. (2001). Can instructors help learners overcome math anxiety? ATEA Journal, 28, 6-10.

Rossnan, S. (2006). Overcoming math anxiety? Mathitudes, 1(1), 1-4.

Skemp, R.R. (1986). The psychology of learning mathematics Penguin, Harmondsworth.

Smith, J. (1996). Efficacy and teaching mathematics by telling: A challenge for reform. Journal for Research in Mathematics Education, 27(4), 387-402.

Trends in International Mathematics and Science Studies (TIMSS, 1999). TIMSS Benchmarking Report Chap6_2, retrieved on 1/12008 from http://timss.bc.edu/timss1999b/mathbench_report/t99bmath_chap_6_2.ht ml.

Tobias, S. (1993). Overcoming Math Anxiety (Revised and Expanded). United States of America: Haddon Craftsmen Inc.

Tsanwani, A. R. (2009). Tracing factors that facilitate achievement in mathematics in traditionally disadvantaged secondary schools. Unpublished PhD thesis. Pretoria: University of Pretoria.

Vinson, B. (2001). A comparison of pre-service teachers' mathematics anxiety before and after a methods class emphasizing manipulative. Early Childhood Education Journal, 29(2), 89-94.

Von Glasersfeld, E. (1991). Radical Constructivism in Mathematics Education, Kluwer Academic Publishers, Dordrecht.

Wilbert, L.T. (2008). High school mathematics teachers' perception of students with math anxiety. Paper AAI3341932: http://digitalscholarship.tnstate.edu/dissertations.

Wood, D. (2006). Coping with math anxiety: A workshop for students [PDF Document]. Retrieved from: http://www.austincc.edu/math/documents.

Zaslavsky, C. (1994). Fear of Math, How to Get Over It and Get On with Your Life, Rutgers University Press, New Brunswick, New Jersey.

Zopp, M.A. (1999). Math Anxiety, the Adult Student and the Community College, Ed. Dissertation, Abstract, Northern Illinois University; 0162.